CHAPTER TWO
HOW TO MAKE A BED?

The Design Methods Movement

The context for Archer's methodological preoccupations lay in new approaches to the design of artefacts, from buildings to consumer goods, which came to brief prominence during the 1960's. While the theories which underlay these approaches were being intensively debated at Ulm, advocates in Britain and North America took a largely atheoretical and pragmatic approach. In this form, new proposals for how design should be carried out became known as 'Design Methods'. The Design Methods movement originated in Britain but achieved a following in North America and some European countries.[1] In essence, the movement's rather disparate protagonists argued that design problems were becoming too complex to be solved by designers working independently and largely intuitively. This situation would be alleviated by 'opening up' and systematising what really went on in the process of design. Input from many sources rather than just the designer would be allowed for, especially at crucial, early stages of the process. In particular, information about user needs would produce a closer fit between these and the designed artefact.

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[1] For a recent reappraisal of the Design Methods movement (in the context of changing definitions of user needs in architecture) see C. Thomas Mitchell, *Redefining Designing, From Form to Experience*, New York, Van Nostrand Reinhold, 1993. Nigel Cross (ed), *Developments in Design Methodology*, Chichester, John Wiley and Sons Ltd, 1984, is a comprehensive collection of writing in the field from the beginning of the Design Methods movement. See also Cross, 'The Recent History of Post-Industrial Design Methods', 1980.

It followed that if the design process was made explicit and systematised, design methods could be drawn up which were 'step-by-step, teachable/learnable, repeatable and communicable procedures for the act of designing'.[2]

The implication that the creative process of design could be reduced to a systematic method, and the complex, often mathematically based techniques advocated for doing this, brought opposition from practising designers, who never embraced the movement to any extent. However, Design Methods became for a while a prominent subject of debate amongst academics in the British design world, particularly in the field of architecture.[3] Some participants clearly saw more in Design Methods than just a solution to individual designer's problems with increasingly complex briefs. As a theoretical underpinning for design and architecture, they offered potential advantage in the university setting, where these subjects had to compete with longer established and more highly theoreticised disciplines.[4]

The movement's founders, both British, are generally held to be the mathematician-turned-architect, Christopher Alexander, and J. Christopher Jones, an industrial designer who had become increasingly involved with ergonomics.[5] Jones co-organized the first Design Methods Conference,

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[2]Cross, 'The Recent History of Post-Industrial Design Methods', p.50.

[3]Architects already had to deal with large numbers of statutory building and planning regulations which lent themselves to systematic treatment. On the other hand, aesthetics and creativity traditionally played a large role in architectural design.

[4] Cross (ed), *Developments in Design Methodology*, p.237.

[5]See Mitchell, *Redefining Designing*, pp.38-60 on Jones' and Alexander's involvement with Design Methods and their subsequent careers.

held at Imperial College, London, in 1962.[6] In 1964, Alexander published

his PhD thesis, the influential *Notes on the Synthesis of Form*, and in 1970

Jones produced the first edition of the textbook*, Design Methods.*[7] For a

decade, Jones taught an experimental course entitled *Design Technology*

at UMIST intended to:

> extend the education of architects, engineers and others to include the new applied sciences that are increasingly relevant to designing and planning the physical environment . . . computing, ergonomics (human factors engineering), operations research, systems engineering, and systematic design methods have been blended together under the title 'design technology' . . . [8]

Jones and Alexander (separately) devised design methods which stressed

user involvement, fitness for purpose and the ideal of a better built world.

In particular, Jones waged a campaign against the scale drawing as 'a very

weak model of the product in use . . . a method of designing a product in

isolation from manufacture and use'.[9] Alexander offered branching

'pictograms' as an alternative, most famously used in his method for the

design of an Indian village, which was presented in an early form at the

1962 Conference.[10] Both Jones and Alexander subsequently abandoned

Design Methods, the former for more extreme forms of experimentation

with creative processes. By the 1970's, Jones was working, for example,

on Enoesque sound compositions and was fascinated by the role of

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[6] J.C. Jones and D. Thornley (eds), *Conference on Design Methods*, Oxford, Pergamon, 1963.

[7] Christopher Alexander, *Notes on the Synthesis of Form*, Harvard, Harvard University Press, 1964, J.C. Jones, *Design Methods*, Wiley, Chichester, 1970.

[8] Mitchell, *Redefining Designing*, p.46.

[9] Quoted in Cross, 'Recent History of Post-Industrial Design Methods', p.51.

[10] Christopher Alexander, 'The Determination of Components for an Indian Village' in Jones and Thornley (eds), *Conference on Design Methods*, pp.83-114.

randomness and chance, rather than rationalism, in composition.[11]

Alexander also rescinded his earlier views. Asked in 1971 what areas

future work in design methodology should centre on, he replied 'I would

say forget it, forget the whole thing. Period.'[12] In retrospect, Jones wrote of

Design Methods that:

> Rationality, originally seen as the means to open up the intuition to aspects
> of life outside the designer's experience, became, almost overnight,
> a toolkit of rigid methods that obliged designers and planners to act
> like machines, deaf to every human cry and incapable of laughter'.[13]

For both Jones and Alexander were 'anti-expert', and had a perspective not

shared by all who published and spoke in favour of Design Methods during

the 1960's. Many of these advocates saw little difficulty in using the

theories and methods of the natural sciences, often in forms adopted by

the applied human sciences, in traditional and 'cyborg' form, to explicate,

and therefore manipulate, the process of design. Particularly, but not only,

among engineers, it was considered largely a matter of applying the

appropriate scientific expertise, with appropriately scientific rigour. The first

contributor to the 1962 Design Methods Conference, for example, spoke

on problems of town and regional planning. He cited with approval Norbert

Wiener's opinion that ' "Econometrics" ', with which he grouped all the

'semi-precise' sciences, 'will never get very far until the observations of the

quantities with which econometrics operates are subject to the same

criteria of precision and rigor as the dynamics by which they are

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[11]Mitchell, *Redefining Designing*, pp.56-60.

[12]Quoted in Cross, *Developments in Design Methodology*, p.312.

[13]J.C. Jones, *Designing Designing*, London, Architecture, Design and Technology Press,1991,
p.174.

combined'.[14] A second contributor spoke on the relevance of system(sic)

engineering to design.[15] A third dealt with the psychology of communication

in problem-solving groups.[16] Yet another offered a 'cybernetic view' of the

design process, in which he asserted that:

The main contention is that a design, *R*, can be identified with the shape of
a trace left upon a malleable environment, *B* (such as an image in
paint upon a piece of canvas, a set of instructions, like a music
score or a choreography), when a *perceptual process* [his italics],
say

$$\Lambda = [\lambda_1, \Rightarrow \lambda_2, \Rightarrow ...\lambda^* \Rightarrow \lambda^*]$$

which is exteriorised in *B*, converges as a result of adaptation or learning to
a stable form λ^* that satisfies an objective of the form "Maximise θ
(X)" (where θ is a functional, determined by a property of *B*, and $x \in$
X are states of *B*, specified in a suitable state description). We also
insist that Λ is partly localized in a "designer", denoted *A*, who
"learns" and "perceives". But *A* may be a man, or a group of men, or
a mechanism, without restriction.[17]

It is perhaps not hard to see why rank and file designers found writing such

as this either incomprehensible or irrelevant, nor why critics of Design

Methods objected to 'the machine language, the behaviourism, the

continued attempt to fix the whole of life into a logical framework'.[18] Tracing

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[14]L.S. Jay, 'A Systematic Approach to the Problems of Town and Regional Planning', in Jones
and Thornley (eds), *Conference on Design Methods*, pp.11-22:16. Wiener, the originator of
cybernetics, coined the term in 1947 (from the Greek for steersman) to convey the primary
concern of cybernetics with the man-machine relationship and with information rather than
matter or energy. Maurice Trask, *The Story of Cybernetics,* London, Studio Vista, 1971,
p.9.

[15]W. Gosling, The Relevance of System Engineering', in Jones and Thornley, *Conference on
Design Methods,* pp.23-32.

[16]B.N. Lewis, 'Communication in Problem-solving Groups', in Jones and Thornley (eds),
Conference on Design Methods, pp.169-184.

[17]G. Pask, The Conception of a Shape and the Evolution of a Design', in Jones and Thornley
(eds), *Conference on Design Methods*, pp 153-167:153. Gordon Pask had his own
department of cybernetics at Brunel University in North London.

[18]Jones, quoted in Cross (ed), *Developments in Design Methodology, p.306.*

the roots of these features, however, and unpicking their embodiment in artefacts designed using these kinds of methods, offers insight into the eventual specification for the King's Fund Bed. Archer became a leading exponent of the Design Methods movement. His own method of systematic design, along with those of Jones and Alexander, was regarded as one of the 'first generation' design methods. While not quite so abstruse as the 'cybernetic' approach quoted above, it certainly shared its principal assumption: the methods of the natural sciences, and the human sciences when closely modelled on them, were legitimately applicable to the process of design.

Science, human science and operational research

The expansion of 'science' in the years after World War Two is well documented.[19] This encompassed not only a hugely increased scale of enterprise within the natural sciences, but a consolidating of the much debated view that they were the obvious and appropriate model for the newer, human sciences. The early twentieth century had seen considerable methodological debate in psychology, anthropology and sociology.[20] By the second half of the century, the natural science model was normative and other approaches were largely defined in opposition to

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[19]Barry Barnes, *About Science*, Oxford, Basil Blackwell Ltd., 1985, pp.3-6, 28-36, and K. Pavitt and M. Warboys, *Science, Technology and the Modern Industrial State*, London, Butterworth, 1977.

[20]See Smith, *History of the Human Sciences*, Ch. 17, 'Natural Science and Objectivity', pp.636-700, and Platt, *A History of Sociological Research Methods in America*, Ch 3, 'Scientism', pp.67-105.

it. This was especially the case in North American institutions whose size and funding made them predominant in sociology and psychology for much of the century. The resolution of the pre-war polarisation between the universities of Columbia and Chicago largely in Columbia's favour is often cited as evidence of this transition. Columbia, under Paul Lazarsfeld, was a centre for quantitative sociology and the survey. Chicago had been home to ethnomethodology, symbolic interactionism and participant observation, the so-called humanistic sociologies. Although Platt suggests, perhaps inevitably, that this is an oversimplified portrayal, she documents 'the commitment to making social science like natural science, and thus with themes such as empiricism, objectivity, observability, operationalism, behaviourism, value neutrality, measurement and quantification.'[21] By the 1950's, some sociologists could write accounts of 'the successful development of a truly scientific sociology'.[22]

The post-war period also witnessed other forms of scientific expansion with considerable implication for the human sciences, notably attempts to create syntheses which encompassed the natural and the human sciences. The new areas of computing and information science began to command resources on an ever increasing scale, and to appear in unusual disciplinary alliances, with psychologists, for example.[23] And attempts were made to apply scientific thinking not only in the still largely academic disciplines of the human sciences, but in the practical world of

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[21]Platt, *A History of Sociological Research Methods in America*, pp.67-8. See also pp.67-105, 200-210, and 256-270 on these issues.

[22]Ibid, p. 67. Platt is referring to John Madge, *The Tools of Social Science,* London, Longmans, 1953.

[23]Pickering, *Units of Analysis*, pp.4-6.

everyday human affairs. In particular, the notion that a science of management was both attainable and desirable gained ground. This was a far more extensive encroachment of scientific method into business (and other) organizations than the pre-war efforts of Taylor and others to maximise efficiency, principally on the shop floor. Post-war management science included earlier time and motion studies of this kind amongst its techniques, but drew also on a variety of new ones which were designed to optimise activity at all levels, from the board room downwards. This latter expansion has been much less studied by historians but the model for the involvement of science in this sphere of human affairs is generally perceived to be operational research: the active involvement of scientists in military strategy and tactics which began during World War Two.

Operational research, a term apparently first coined in British radar research in the late 1930's, entailed the application of science to problems involving human and machine resources on a large scale.[24] As indicated by its name, operational research was regarded as a problem solving discipline, applicable to individual situations where practical action was required, rather than a means of discovering fundamental new knowledge.[25] It had been rated a considerable success in both the British and US war effort. Instead of concentrating on laboratory-based tasks such

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[24]Most accounts of British military operational research locate its origins in the involvement of physicists with radar in aircraft detection just before World War Two. The practical problems of making radar an effective defence from air attack were rapidly identified as differing from its study under laboratory conditions. Hence two groups were set up: 'radar research' and 'operational radar research'. The term radar was dropped from the latter when similar methods began to be applied to other areas of research. See for example, Rivett, *Concepts of Operational Research*, pp.5-6.

[25]It was 'a collection of disciplines, brought together for the purposes of making a scientific attack on practical problems'. Nuffield Provincial Hospitals Trust,*Operational Research in the Health Service*, Oxford University Press, 1962, p.v.

as developing new explosives, scientists were invited to examine issues of 'man-machine' interfaces, strategy and tactics. In the British forces, successes included the re-design of tanks and maximising the rate of hits in anti-submarine warfare.[26]

The success of operational research in achieving military objectives was not overlooked in peacetime. If scientific methods could help large organizations of people and resources win wars, might they not, with advantage, be applied to achieving peacetime goals where large organizations of human and material resources were involved? Release of official records of operational research activities in the British Forces began in the 1950's, but advocates, most of whom had gained first hand experience in the military context, began speaking and writing about operational research and related practices soon after the war ended.[27] The first international conference on operational research was held in Oxford in 1957. By that time the fields of application for publications in operational research were as likely to be in the civilian, as the military sphere. *A Guide to Operational Research*, by Eric Duckworth, first published a few years later in 1962, defined it without reference to a military context. Operational Research was 'the study of administrative systems pursued in the same scientific manner in which systems in physics, chemistry and biology are studied in the natural sciences'. 'Since 1950', the author continued, 'operational research has spread rapidly into

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[26]Rivett, Concepts of Operational Research, pp.7-11.

[27]Hywel Murrell, for example, initiated the Ergonomics Research Society in 1949, and their conference in 1951 in Birmingham 'to put ergonomics before industrialists'. He had been a member of the Army Operational Research Group, Section 9, which had been set up at the instigation of the MRC 'to assess man/machine/task efficiency'. Hywel Murrell, 'How Ergonomics became part of Design' in N. Hamilton (ed), From Spitfire to Microchip: Studies in the History of Design from 1945, London, Design Council, pp.72-79.

the industrial field. It is now used extensively in general engineering . . . It is also used in civil government . . . and in hospitals.'[28] This influential textbook was, first and foremost, written for the manager. The techniques of operational research were to have their greatest peacetime application in what came to be called, not surprisingly, management science. Institutional links were strong. The College of Aeronautics at Cranfield in Surrey was ultimately to become home to the prestigious Cranfield Business School.[29] Individuals trained in operational research were appointed to senior positions in industry during the 1960's. C.P. Torrie, for example, dubbed the 'high priest of work study' was highly influential at ICI.[30] Mathematical techniques, such as those originally devised to solve problems of supply and landing at airfields, became the basis of 'a vast literature on queuing theory and stock problems generally'.[31] Although, as the war years receded, specific references to the original military applications of particular techniques were generally omitted, an overall debt to operational research was regularly acknowledged in the new genre of books on business studies which appeared in the post-war period. [32]

It was less often acknowledged, but clearly the case, that the Design

[28] Eric Duckworth, *A Guide to Operational Research*, London, Methuen, 1962 (1965 edn.) pp.8 and 124.

[29] The College of Aeronautics became The Cranfield Institute of Technology in 1969 and Cranfield University in 1993. For a history see Revel Barker, *Field of Vision:Cranfield University, the First 50 Years*, Cranfield, Cranfield University Press, 1996.

[30] In 1958, ICI was said to employ 1400 work study officers. This was four times as many as any other company in the world. Whitston, 'The Reception of Scientific Management by British Engineers' p. 228.

[31] R.T. Eddison et al., *Operational Research in Management*, London, English Universities Press, 1962, p.124.

[32] Ibid, p.213, for example.

Methods movement owed a similar debt to operational research, either directly or in its 'management science' guise. To take but one example, the central part of the paper to do with problem solving at the 1962 Design Methods Conference, was taken up with 'the first detailed report of (an) apparatus, its rationale, and its potency for manipulating problem-solving groups.' This consisted of a game playing console displaying 81 diagrams of aircraft with varying engine size, trajectory, ambient weather conditions and location over England, France or Germany.[33] When writers on Design Methods did acknowledge the role of operational research in devising the techniques they now borrowed, most did so uncritically. 'The leaning towards such operational concepts as "model", "systems" and "simulation" . . . are seen as an inevitable outcome of the struggle of thoughtful men to understand what they wish to change.' wrote one.[34] A lone voice at the 1962 Conference opined that 'what we can learn from operational research is not the direct example of immediately applicable methodologies, but the indirect example of how they solved their own problems'.[35] Most proponents of Design Methods, however, including Archer himself, had little hesitation in applying the techniques of operational research in a very direct fashion. By the time of the third Design Methods Conference in 1969, two years after the King's Fund Bed Project was completed, he presented a sustained and extensive attempt to describe the design process in mathematical terms entitled *The structure of the design*

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[33] B.N.Lewis, 'Communication in Problem-solving Groups', p.171.

[34] L.S. Jay, 'Problems of Town and Regional Planning', quoting J.W. Dykman, p.20.

[35] Joseph Esherick, 'Problems of the Design of a Design System', in Jones and Thornley (eds), *Conference on Design Methods*, pp.75-81:86.

process.[36] In it he clearly identified the various mathematical techniques employed, and their derivation from operational research. This paper was a shorter version of his doctoral thesis.[37] Although Archer later came to consider he had 'wasted a lot of time trying to bend the methods of operational research and management techniques to design purposes', these methods had clearly preoccupied him during the time of the bed project.[38]

Archer's Design Method

In 1963-4, the first year of the King's Fund Bed project, Archer published a series of seven articles in *Design* under the general title of *Systematic Method for Designers*. The articles were re-published, with some revision, as a booklet under the same title by the Council of Industrial Design in 1965.[39] They were apparently based on the working documents prepared with Butter during the Nuffield-funded year of research on hospital equipment. Taken together, his early drafts and published papers provide insight into the design method which Archer had been gradually refining over a period of years which coincided almost exactly with the timing of the bed project. Of the four case studies appended to the COID booklet,

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[36] L.B. Archer, 'The structure of the design process', in Geoffrey Broadbent and Anthony Ward (eds), *Design Methods in Architecture,* London, Lund Humphries, 1969, pp.76-102.

[37] Published in 1969 by the U.S. National Bureau of Standards as *The structure of design processes*.

[38] L. B. Archer, 'Whatever became of Design Methodology?' in Cross (ed), *Developments in Design Methodology*, Chichester, John Wiley and Sons Ltd, 1984, pp.347-349:347.

[39] L. Bruce Archer, *Systematic method for designers*, London, COID, 1965.

number one (an apparatus designed by an Ulm student for the calibration
of a radio pill which, when swallowed, monitored the pH of the digestive
tract) was described as among the first serious attempts to apply the
principles described in the booklet. The third (the ward medicine trolley
designed at the end of the Nuffield sponsored year) was described as
having been 'selected expressly to test and demonstrate research and
design techniques as far as they had then been developed'. The fourth
case study was the Kings Fund bed itself, and Archer recorded that
revisions made to the checklists (a central feature of his method) were
derived largely from a study of the records of that project.[40]

Like most advocates of Design Methods, Archer began by urging
that they were necessary because design problems had become too
complex for the designer to use 'traditional' methods, or 'rules of thumb'.
Like many, too, he considered that ways had to be found to 'incorporate
knowledge of ergonomics, cybernetics, marketing and management
science into design thinking.'[41] These were, however, additional to a
technique of central importance:

> The most fundamental challenge to conventional ideas on design, . .
> . has been the growing advocacy of systematic methods of problem
> solving, borrowed from computer techniques and management
> theory, for assessment of design problems and the development of
> design solutions.'[42]

The origins of decision theory are generally described as lying in
political economy and traced back to Jeremy Bentham and the concept of

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[40]The second example was the wristwatch designed by Reinhart Butter under Archer at Ulm.

[41]Archer, *Systematic method for designers*, p.3.

[42]Ibid.

economic man, a completely rational being who, under conditions of certainty (that is when the consequences of choices were known) consistently made decisions to maximise utility.[43] Psychologists adopted different models of how individuals make choices and the subject became of increasing interest in commerce because of its relevance to consumer choice during the twentieth century. Scientists involved in military strategy and tactics routinely drew on this work in devising optimisation techniques. John von Neumann and others theorised decision making under uncertainty into 'game theory'.[44] In these guises many elements of decision theory were incorporated into management science.

The subject had interested Archer at least since his time at Ulm, where it had often been discussed with Horst Rittel and others.[45] His reports on the Nuffield-funded research on hospital equipment had referred to the use of decision theory in the design process, and when the Kings Fund had taken over the project in early 1963 the first working meeting at the Fund began with Archer 'giving a resume of his theory of decision making'. [46] Although there was no reference to decision theory in the published report of the King's Fund Bed project, this was perhaps due to the rather antipathetic response to his theories displayed by some of the King's Fund Working Party.[47]

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[43]Ward Edwards, 'The Theory of Decision Making', *Psychological Bulletin* 51, 4, 1954, pp.381-417 reviews the field up to the early 1950's.

[44]Heims, *Constructing a Social Science for Postwar America*, p.109-110.

[45]Interview, Bruce Archer, 10.5.99.

[46]Notes of a meeting at the Hospital Centre, 23.5.63, A/KE/PJ/17/1.

[47]When the Working Party met representatives of the South West Metropolitan Regional Hospital Board in connection with the research which Archer's team had intended to carry out on equipping the new West Middlesex hospital, they found a 'general opinion that Archer's method was little more than the application of common sense wrapped up in

Before proceeding to outline his design method utilizing decision theory Archer devoted the first article in the series *Systematic Method for Designers* to a necessary prerequisite: a discussion of the relationship between aesthetics and logic. The separation of 'aesthetics', which he equated with 'matters of value', and 'logic' which he defined as 'matters of fact', exercised many advocates of Design Methods (and decision theory). This was principally because 'matters of fact' were usually susceptible to measurement, thus providing data in an abstract, quantitative form to which the mathematical techniques employed in decision theory could be applied. Matters of value, however, were more problematic. Archer considered that matters of value, or aesthetics, were of two kinds: 'descriptive aesthetics' and 'ethical aesthetics'. Descriptive aesthetics, by which he meant what is generally meant by the word aesthetics in most discourses other than philosophy, that is beauty, or appearance, caused him little difficulty. Issues of descriptive ethics were 'eminently soluble by the methods of the physical sciences . . . Descriptive aesthetics . . . deals with empirical facts about perceivable qualities and the statistics of preferences . . . Thus, descriptive ethics is a natural science, like physiology.' With this somewhat sweeping statement he dismissed the issue. Certainly, there were techniques then current in applied and social psychology which produced quantitative results in the field which Archer designated 'descriptive aesthetics'. A large body of work had been done before and after World War Two on scaling, including the scaling of opinion and preference. As Platt points out, 'Scaling is connected with the theory of measurement and provides a relatively firm foundation for quantification,

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some high flown verbiage' and that he 'needed to be kept on the rails'. Notes of a meeting at South West Metropolitan RHB, 7.8.63, A/KE/PJ/17/1.

by making it possible to claim accurate and meaningful measurement of degrees of intensity; this translates attributes into variables, and means that the data collected can be much more effectively manipulated mathematically'.[48] Special techniques of asking questions had been devised. It was found, for example, that subjects could not consistently rank large numbers of preferences, but could do so if they were presented in pairs and the rank order compiled from this procedure.

Archer also used these 'binary' methods of questioning when dealing with what was to him the more problematic area of 'ethical' aesthetics. By ethical aesthetics, Archer meant 'wrongness' or 'rightness', or 'appropriateness'. Allowing that decisions in this area were indeed 'value judgements', and not amenable to the same numerical logic as physical science, he solved the dilemma by contending that they *were* amenable to a sort of 'case-law' logic. By this he meant, essentially, appeal to a consensus of informed opinion. Furthermore, this case law logic *could* be described in terms of mathematics, albeit of the non-quantitative kind, such as Boolean algebra. (Such techniques were subsequently used to incorporate 'expert opinion' into decision making computer programmes.) Archer referred to his solution to the problem of ethical aesthetics as 'practical science', a subject I will return to in Chapter Six.

The introduction to the second article, entitled 'The nature of designing', began with theoretical assumptions which are perhaps unsurprising given prevailing views in the disciplines which Archer considered appropriate to inform his method. He asserted that design began with a need, the art of designing was the art of reconciling conflicting

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[48]Platt, *A History of Sociological Research Methods in America*, p.28.

requirements and resolving conflict, it was a 'goal-seeking activity' or a 'cybernetic or goal-directed problem solving activity'. Pickering has drawn attention to the kind of psychology which informed the 'cyborg' sciences. The behaviourist and functionalist assumptions shared by most proponents of Design Methods in the 1960's have been pointed out by several historians of the movement. They did not go unnoticed by some critics at the time, and they were made much of in the general rejection of Design Methods that came in the 1970's. (see Chapter Six).

Borrowing another concept from the 'cyborg' sciences, Archer noted that many contemporary fields now preferred to consider 'systems' rather than 'self contained units'. He went on to describe 'the basic system at the point of use' of the artefact to be designed, which he chose to describe as a man-tool-work-environment system'.

The term 'environment' was used in the behaviourist sense to mean all uncontrollable variables. This was clearly based on the work done with Butter, where the same system is outlined.[49] The system was said to 'imply' eleven activities, such as man operates tool, tool reacts on man, work acts on environment, environment acts on tool and so on. These activities were said to 'involve considerations', reducible to three 'human factors' (motivation, ergonomics, aesthetics), three technical factors (function, mechanism, structure) and three 'further' factors (production, economics, presentation). Admitting that 'these lists are neither exhaustive nor exact', Archer considered that the tables formed 'a useful basis for the evolution of checklists and analytical systems'. He drew the reader's attention to the difference between the fundamental qualities of the factors. Some, such as

[49]AAD/1989/9, Job 1, Working Documents 1-5.

structure and economics, were susceptible to measurement which could be 'optimised by conventional methods of calculation.' Others, such as motivation and aesthetics, which related to matters of value, could only be assessed using the sort of 'case law' he had introduced earlier. (Presumably descriptive aesthetics fell into the former type, and was exempt from this proviso). Then asserting that design problems were therefore comprised of thousands of subproblems, each of which could be solved in an appropriate way to an optimum or acceptable solution, 'the hard part of the task is to reconcile the solutions of the sub-problems with one another'. Accepting the optimum for one sub-problem might entail a poor solution for another. Structuring the design process in this way allowed Archer to apply the decision making techniques in which he was keenly interested.

Article three, entitled 'Getting the brief', explored a further issue central to the Design Methods movement, that of eliciting 'user needs'. According to Archer 'the awareness of need' in the client had to be translated into goals for the designer by 'defining the needs and pressures which constitute the driving force for change'. Here he made explicit use of a cybernetic model, in turn derived from behaviourist learning theory, which he considered to show 'the way in which, in nature, day to day problems are solved. The identification of goals was to be followed by the identification of 'constraints'. These would in turn define the' field of manoeuvre', in which 'crucial issues' were to be identified. The designer was then, again following a cybernetic model, to review his experience of analogous problems and suggest an approximate solution. Archer noted that at this stage his method had involved little or no data analysis, but the problem had been defined and a course of action formulated. This, it

seems, was at least partly due to the practicalities of design contracting. 'Most designers must submit an outline programme with estimates of costs for approval before the work of evaluating data and developing solutions can be undertaken'. Assuming that approval was received, the designer could then proceed to find answers to the questions he had posed.

Article four, *Examining the Evidence*, outlines methods for finding 'information'. These might include starting with a kind of brainstorming, which produced random factors.[50] Alternatively, a thesaurus, or a checklist (Archer's favoured method) was advocated, and information gathered around these. 'From this a list of all matters requiring evaluation and decision is prepared, and where the solution of one of these impinges on another, the two are paired to make a sub-problem.' The sub-problems were tackled by appropriate methods, ('there is a technique appropriate to every problem') which ranged from quantitative optimisation to the use of 'informed opinion' as in the 'case-law' model, and then the sub-problems rank ordered in case of incompatible solutions. A binary chart was advocated here, which would rank order the problems according to how many others they interacted with. At the end of this stage, 'all the facts about the characteristics of the product, and all the facts about the limitations of the means for producing, marketing and using it, are assembled into a performance specification.' In effect, 'the whole design problem is expressed as a rank ordered list of the attributes which the final solution is required to have. This much might well be computerised. The result, however, was again a statement of the problem, not of the answer.'

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[50]Alexander advocated this course of action in his design method. Brainstorming was considered to be a highly innovative and potentially valuable technique in the early 1960's. See J. C. Jones, 'Design Methods Compared, 2: Tactics', *Design*, 213, 1966, pp.46-52:47.

The abstract and mathematical character of this line of thought is clear, as is an implicit assumption that a sufficiently full and exact exposition of a problem would contain its solution.[51] For the hospital bed project however, or indeed for any project to design an artefact, the way in which the problem was constituted prefigured the way in which it would be answered, and consequently the nature of the resultant artefact. The abstraction of complex problems in the social world to mathematics was to prove a highly deterministic method. And the great emphasis placed on decision theory and problem solving techniques meant that the defining of the problem occupied far more pages in this exposition of Archer's method than did the subsequent stages of designing hardware to answer the problem, feasibility testing and communicating with manufacturers. This was an emphasis which had already been demonstrated in Archer's approach to the Nuffield sponsored project, where problem defining had taken the entire first year. It was an emphasis that would recur in full measure during the course of the King's Fund Bed project. That project, being a request for an abstract specification, in effect a statement of the design problem, rather than an embodiment of any one solution, was particularly well suited to the method.

In the remaining articles in the series, Archer addressed the issue of the 'Creative Leap' and the 'Donkey Work', that is 'making a selected design idea work'. Creativity was always problematic for advocates of Design Methods, some of whom argued that truly systematic and logical design procedures would replace it completely, whatever it was. Rather

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[51]This implicit assumption of several early design methods was pointed out in Philip Steadman, 'An Evolutionary Approach', *Design Research and Methods*, 7, 2, 1973, pp.90-92:91.

than argue designers out of a job altogether however, more sophisticated advocates provided various accounts of the creative process. Archer described the 'creative leap' (significantly, an event, not a process) as 'an essential element, distinguishing design from certain other problem solving activities' and explained it with reference to scientific 'uncertainty principles' and the transactional school of perception. I shall discuss his views on 'making a selected design idea work' in Chapter Three, since they relate largely to the building and testing of models and prototypes.

Overall, Systematic Method for Designers drew on an eclectic mixture of scientific and scientistic disciplines. Archer recalled the impact of the release of details of war-time operational research in the 1950's. 'We were buzzing with the new ideas'.[52] The cyborg sciences in particular were espoused enthusiastically in a liberal humanist ethos of reconstruction and reform. A belief in their potential for good was unexceptional at the time.[53]

Systematic method for Designers was a programmatic statement largely written before the King's Fund Bed Project, but given the timing, the project's outcome could hardly fail to be regarded as a vindication or otherwise of the methods advocated. Its overall rhetoric was an advocacy of rigour, the assumed rigour of scientific method. This rhetoric was to do useful work in the social world, above and beyond any contribution to the procedures adopted.

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[52]Interview, Bruce Archer, 9.5.00.

[53]The polymath, Gregory Bateson, considered cybernetics to be 'one of only two moments in his lifetime that would rate as really important from an anthropologist's point of view' (the other concerned the negotiation of the Treaty of Versailles). Gregory Bateson, *Steps to an Ecology of Mind*, London, Paladin,1973, p.445.